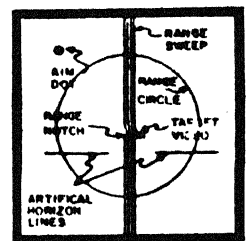
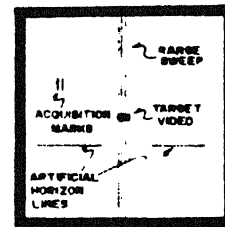
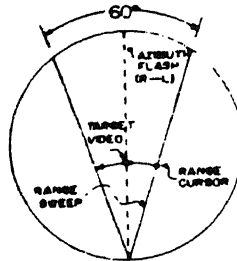
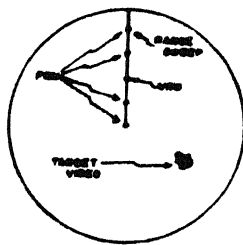


STUDENT WORKBOOK

FOR

ADVANCED FIRST-TERM AVIONICS COURSE

CLASS A1
C-100-2010



UNIT VII

CNTT-M1705

PREPARED BY
NAVAL AIR TECHNICAL TRAINING CENTER
NAVAL AIR STATION MEMPHIS
MILLINGTON TENNESSEE

PREPARED FOR
CHIEF OF NAVAL TECHNICAL TRAINING

JUNE 1984

FOREWORD

This Student's Guide has been provided for your use while attending the Advanced First-Term Avionics Course. The proper use of this book will greatly enhance your understanding of the material presented during Unit VII. You may enter any information you deem necessary in order to successfully complete the objectives. This book contains all homework assignments, information sheets, note-taking sheets, and job sheets required in the classroom and laboratory environment of Unit VII. The notetaking guides for each lesson topic provide you with a rough outline of the lesson being covered. Appropriate use of these guides will greatly improve your comprehension of the material presented.

SAFETY NOTICE

As an avionics technician, you will be required to perform safe and efficient maintenance on various types of aircraft and equipment. Not only your life, but the lives of many others could depend on you doing your job in a safe manner. It is the responsibility of all Navy and Marine Corps personnel to prevent accidents. This can be done if everyone develops and practices good safety habits.

In Unit VII, you will be required to troubleshoot the 11D13 Radar Trainer down to a defective component. In order to accomplish this task you must analyze display data and the appropriate test points. There are high voltages used in the circuits of the 1500 unit. Great care must be taken when working on the trainers. Aside from actual injury from an electrical shock, equipment damage can also occur. By being careful and paying attention to detail, the risk of an unfortunate incident occurring will be greatly reduced.

GOOD LUCK AND BE ALERT!!!!!!!!!!!!!!

HOW TO USE THIS STUDENT'S WORKBOOK

This Student's Workbook has been prepared for you to use while attending Unit VII of the AFTA (Class A1) course.

Proper use of this guide should improve your understanding of the material presented tremendously.

This volume contains the following:

1. Unit VII class schedule.
2. Unit VII homework schedule.
3. Unit VII learning objectives.
4. Assignment sheets which enhance your understanding.
5. Information sheets which provide additional material.
6. Notetaking sheets which provide a rough lesson topic outline.
7. Job sheets which will direct you in performing the laboratory assignments.

UNIT V CLASS SCHEDULE

Unit VII is two weeks long. It starts in the middle of the fifth day of the twelfth week. The instructional periods run from 477 through 556 with the last period ending on the middle of the fifth day of the fourteenth week.

The schedule is as follows:

OPIC NO.	TYPE	PERIOD	TOPIC
TWELFTH WEEK			
Fifth Day			
	Class	477	Indicator Video Unit
		478	
		479	
		480	Direct-View Storage Tube
THIRTEENTH WEEK			
First Day			
		481	B-Gun Display Generation and
		482	Sequence
		483	
		484	
		485	
		486	
		487	
		488	
Second Day			
	Class	489	A-Gun Display Generation and
		490	Sequence
		491	
		492	
		493	
		494	
		495	
		496	

THIRTEENTH WEEK

Third Day

Lab	497	Display Analysis Checks
	498	
	499	
	500	
	501	
	502	
	503	
	504	

Fourth Day

Class	505	Introduction to Troubleshooting
	506	
	507	
	508	
	509	
	510	
	511	
	512	

Fifth Day

Class	513	Unit/Module Test: Criterion
	514	Test/Written Examination
	515	
	516	
Class	517	Logical Troubleshooting (PI)
Lab	518	Radar Troubleshooting
	519	
	520	

FOURTEENTH WEEK

First Day

521	Radar Troubleshooting
522	
523	
524	
525	
526	
527	
528	

FOURTEENTH WEEK

Second Day

Lab	529	Radar Troubleshooting
	530	
	531	
	532	
	533	
	534	
	535	
	536	

Third Day

Lab	537	Radar Troubleshooting
	538	
	539	
	540	
	541	
	542	
	543	
	544	

Fourth Day

Lab	545	Radar Troubleshooting
	546	
	547	
	548	
	549	
	550	
	551	
	552	

Fifth Day

Lab	553	Unit Module Test: Criterion Test/Performance Test
	554	
	555	
	556	

UNIT VII HOMEWORK SCHEDULE

All of the assignment sheets listed below shall be turned in when due. Each assignment sheet will be checked by an instructor for completeness and correctness. Failure to turn in an assignment sheet could result in disciplinary action.

Assignment Sheet	Period Due
7.1.1A	481
7.3.1A	489
7.4.1A	497

UNIT VII LEARNING OBJECTIVES

TERMINAL OBJECTIVE

- 12.0 ISOLATE an instructor-induced malfunction (under limited supervision) in an avionics RADAR training device to a weapons replaceable assembly, a shop replaceable assembly, a stage, and a component and RECORD results on job sheets. Test equipment will be provided. Performance must be accomplished in accordance with the Maintenance Handbook for Basic Fire Control Radar Maintenance Training Sets, Devices 11D13 and 11D13A, Vol. I and II, NAVEDTRA P-2974-1. All general and personal safety precautions must be observed in accordance with OPNAVINST 5101.2 (series).
- 12.1 EXTRACT troubleshooting and performance data from given block and schematic diagrams of an avionics RADAR training device. All circuit performance and operating characteristics will be documented on job sheets in accordance with specifications contained in the Maintenance Handbook for Basic Fire Control Radar Maintenance Training Sets, Devices 11D13 and 11D13A, Vol. I and II, NAVEDTRA P-2974-1.
- 12.2 PERFORM visual inspections on an avionics RADAR training device for physical defects, security, integrity, and proper installation and RECORD results on a job worksheet. Performance must be accomplished in accordance with procedures outlined in the Maintenance Handbook for Basic Fire Control Radar Maintenance Training Sets, Devices 11D13 and 11D13A, Vol. I and II, NAVEDTRA P-2974-1.
- 12.3 PERFORM operational and minimum performance checks (under limited supervision) on an avionics RADAR training device and RECORD results on job data sheets. Necessary test equipment will be provided. Performance must be accomplished in accordance with the Maintenance Handbook for Basic Fire Control Radar Maintenance Training Sets, Devices 11D13 and 11D13A, Vol. I and II, NAVEDTRA P-2974-1. All general and personal safety precautions must be observed in accordance with OPNAVINST 5101.2 (series).
- 12.4 ISOLATE an instructor-induced malfunction (under limited supervision) on an avionics RADAR training device to a weapons replaceable assembly, a shop replaceable assembly, a stage, and a component and RECORD results on job sheets. Test equipment will be provided. Performance must be accomplished in accordance with the Maintenance Handbook for Basic Fire Control Radar Maintenance Training Sets, Devices 11D13 and 11D13A, Vol. I and II, NAVEDTRA P-2974-1. All safety precautions must be observed in accordance with OPNAVINST 5101.2 (series).

- 12.5 DOCUMENT, on the VIDS/MAF, all necessary corrective actions required in a given maintenance situation to restore an avionics RADAR training device to an operational condition. Documentation must include the ordering and receipt of parts. All documentation must be legible and in accordance with OPNAVINST 4790.2 (series).

TABLE OF CONTENTS

FRONT MATTER	Page
Foreword	i
Safety Notice.	ii
How to Use the Student's Workbook.	iii
Unit VII Class Schedule.	iv
Unit VII Homework Schedule	vii
Unit Learning Objectives	viii
 WORKBOOK MATERIALS	
Assignment Sheet 7.1.1A	1
Information Sheet 7.1.1I	5
Notetaking Sheet 7.1.1N	9
Assignment Sheet 7.3.1A	19
Notetaking Sheet 7.3.1N	23
Assignment Sheet 7.4.1A	29
Notetaking Sheet 7.4.1N	35
Job Sheet 7.5.1J	41
Appendices	57

ASSIGNMENT SHEET 7.1.1A

INDICATOR VIDEO UNIT

INTRODUCTION

The purpose of this assignment sheet is to provide you with a review of the Indicator Video Unit's purposes, component functions, and overall circuit operation. The completion of this assignment will enhance your comprehension of the material presented on the Indicator Video Unit. After completing this assignment, you will be better able to trace signal flow, identify component functions, and explain the internal circuit operation.

LESSON TOPIC LEARNING OBJECTIVES

- 12.4 ISOLATE an instructor-induced malfunction (under limited supervision) on an avionics RADAR training device to a weapons replaceable assembly, a shop replaceable assembly, a stage, and a component, and RECORD results on job sheets. Test equipment will be provided. Performance must be accomplished in accordance with the Maintenance Handbook for Basic Fire Control Radar Maintenance Training Sets, Devices 11D13 and 11D13A, Vol. I and II, NAVEDTRA P-2974-1. All safety precautions must be observed in accordance with OPNAVINST 5101.2 (series).
- 12.4.121 SELECT, from a given list, the purpose, characteristics, and circuit operation of the PPI range gate.
- 12.4.122 SELECT, from a given list, the purpose, characteristics, and circuit operation of the pedestal bootstrap generator.
- 12.4.123 SELECT, from a given list, the purpose, characteristics, and circuit operation of the deflection signals to the A-scope.
- 12.4.124 STATE the purpose of the azimuth mark generator.

STUDY ASSIGNMENT

1. Study Notetaking Sheet 7.1.1N.
2. Complete study questions on Assignment Sheet 7.1.1A.

STUDY QUESTIONS

1. What are the functions of the Indicator Video Unit?
2. What is the purpose of R1460?
3. What is the purpose of R1461?
4. Where is the PPI range gate developed?
5. What component PRIMARILY determines the pulse duration of the PPI range gate?
6. Q5 and Q6 of the A1511 board make up what type of circuit?
7. What signal triggers Q5 and Q6 into operation?
8. What component serves as a calibration adjustment for the PPI range gate?
9. What are the approximate pulse durations of the waveform at Q6's collector for all possible ranges?
10. The pulse taken from Q1 A1518 is used to trigger what circuits?
11. What component adjusts the amplitude of the waveform from the collector of Q7 A1518 board?

12. V1401 and associated circuitry make up what type of circuit?
13. Why is R1437 included when in the 6,000 yard range?
14. What type of waveform will V1401 produce if the 40,000 or 80,000 yard range is selected?
15. What component provides feedback for the bootstrap?
16. CR1401 serves as a _____ diode.
17. What is the vertical center adjustment for the PPI mode?
18. What does K1404 do to the physical length of the waveform at TP1402 when the bomb director mode is selected?
19. What is the purpose of the azimuth mark generator?
20. What does the polarity of the input from R1490A indicate?
21. R7 and L1 in the azimuth mark generator make up what type of circuit?
22. A1 is a/an _____ multivibrator.
23. CR1 and CR2 make up a/an _____.
24. The output of A1404 is taken from the collector of Q2 as what type of waveform?

25. What are the inputs to the video mixer?
26. What is the purpose of R14111?
27. How are the range marks disabled to the higher ranges?
28. Composite video is applied to the _____ of the PPI indicator.

INFORMATION SHEET 7.1.11

INDICATOR VIDEO UNIT

INTRODUCTION

This information sheet is designed to aid you in learning the operational controls of the Indicator Video Unit. By using this information you will better understand the operational controls, their purpose, characteristics, location (both physically and schematically) and their circuit operation.

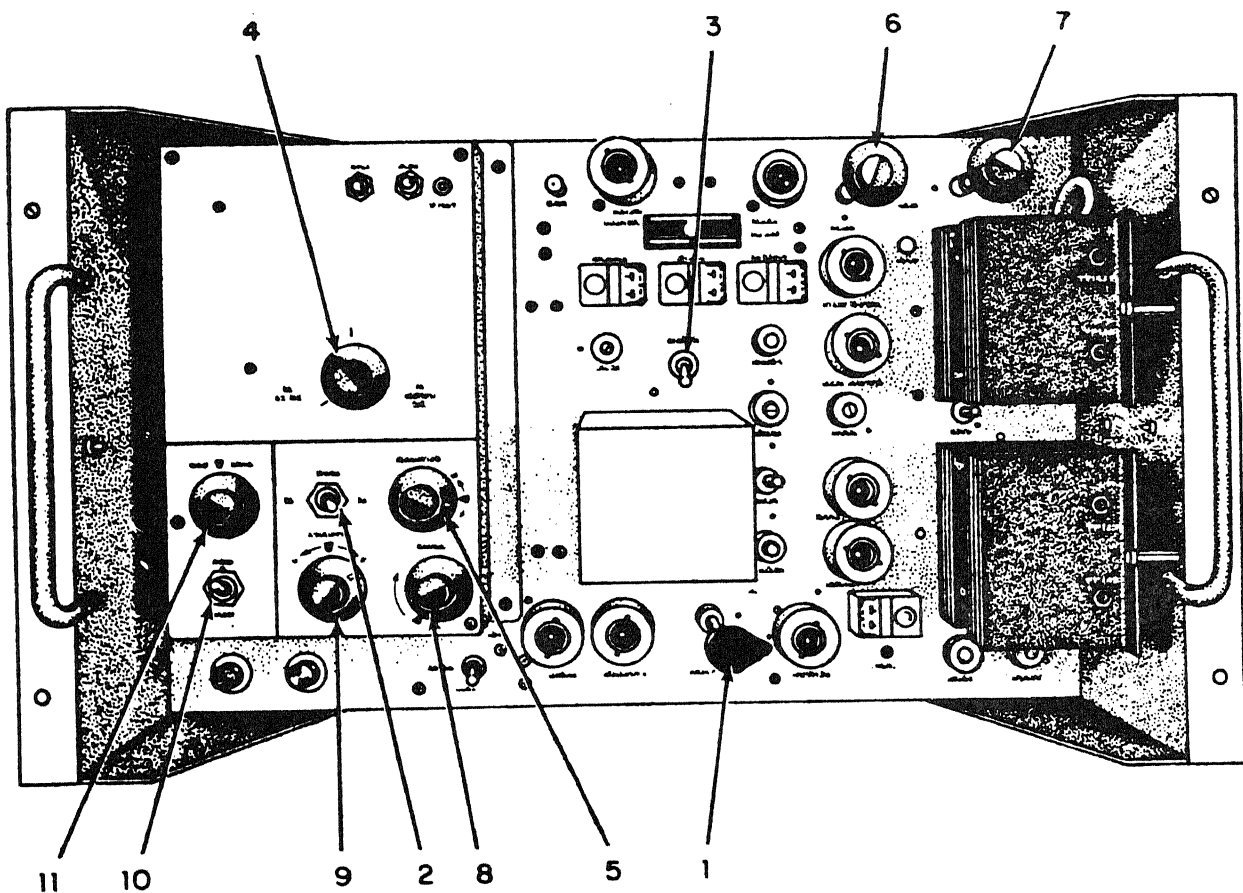


FIGURE 1

NOTE: All physical locations of the following components are indicated in Figure 1 above.

COMPONENT	LOCATION	FUNCTION
1. Range Selector Switch (S1401)	Schematic book, S1401A p. 15 S1401B p. 16	Selects proper range for PPI, Bomb Director, and Fire Control modes. Disables range marks in the 10, 40, and 80 thousand yard ranges.
2. Mode Select Switch (S1406)	Schematic book, p. 16	Selects Bomb Director or Fire Control mode.
3. Scan Control Switch (S1405)	Schematic book, p. 16	Selects PPI or SECTOR scans.
4. B/D AZ MK-FC SECTOR CENTER Control (R1443)	Schematic book, p. 16	Controls the azimuth position of the azimuth flash in Bomb Director. In Fire Control, it controls the sector center position of the antenna scan.
5. Elevation Control (R1477)	Schematic book, p. 16	Controls the elevation of the antenna in all modes and submodes <u>except</u> Fire Control Automatic Track.
6. Video Amplitude Control (R14111)	Schematic book, p. 16	Controls the amplitude of the target video to the PPI indicator and to the VIDEO GAIN control for the Fire Control scope.
7. Range Mark Amplitude Control (R14108)	Schematic book, p. 16	Controls the brightness of the range marks on the PPI indicator.
8. Manual Range Control (R1461)	Schematic book, p. 16	Controls the range position of the range cursor in the Bomb Director mode. Controls the range position of the acquisition marks from 0 to 40,000 yards in the Fire Control mode.

COMPONENT	LOCATION	FUNCTION
Land Azimuth Control (R1460)	Schematic book, p. 16	Controls the azimuth position of the acquisition symbols in the Fire Control Auto- matic Search submode. Controls the azimuth position of the acquisition symbols and the antenna in the Fire Control Manual Search submode.
AUTO-MAN SELECTOR switch (S1404)	Schematic book, p. 16	Selects automatic or manual antenna scans. In AUTO the antenna will rotate at 6 rpm in a clockwise direction. In MAN the antenna will rotate clockwise or counterclockwise from 0-6 rpm depending on the setting of SCAN RATE CONTROL (R1452).
SCAN RATE Control (R1452)	Schematic book, p. 16	When S1404 is in the MAN position, R1452 controls the direction and speed of the antenna. The speed is controllable from 0.6 rpm.

NOTETAKING SHEET 7.1.1N

INDICATOR VIDEO UNIT

REFERENCES

1. Aviation Fire Control Technician 3 & 2, NAVEDTRA 10387-B, Chapter 12, pages 332-336.
2. Maintenance Handbook for Basic Fire Control Radar Maintenance Training Sets, Devices 11D13 and 11D13A, NAVEDTRA P-2974-1, December 1968, Section 3, "Theory of Operation", pages 3-54 through 3-61.

NOTETAKING OUTLINE

I. Functions of the Indicator Video Unit

- A.
- B.
- C.
- D.

II. Operational Controls

NOTE: Operational Controls and their functions are listed on Information Sheet 7.1.1I.

III. PPI Sweep Generation and Drive Circuits

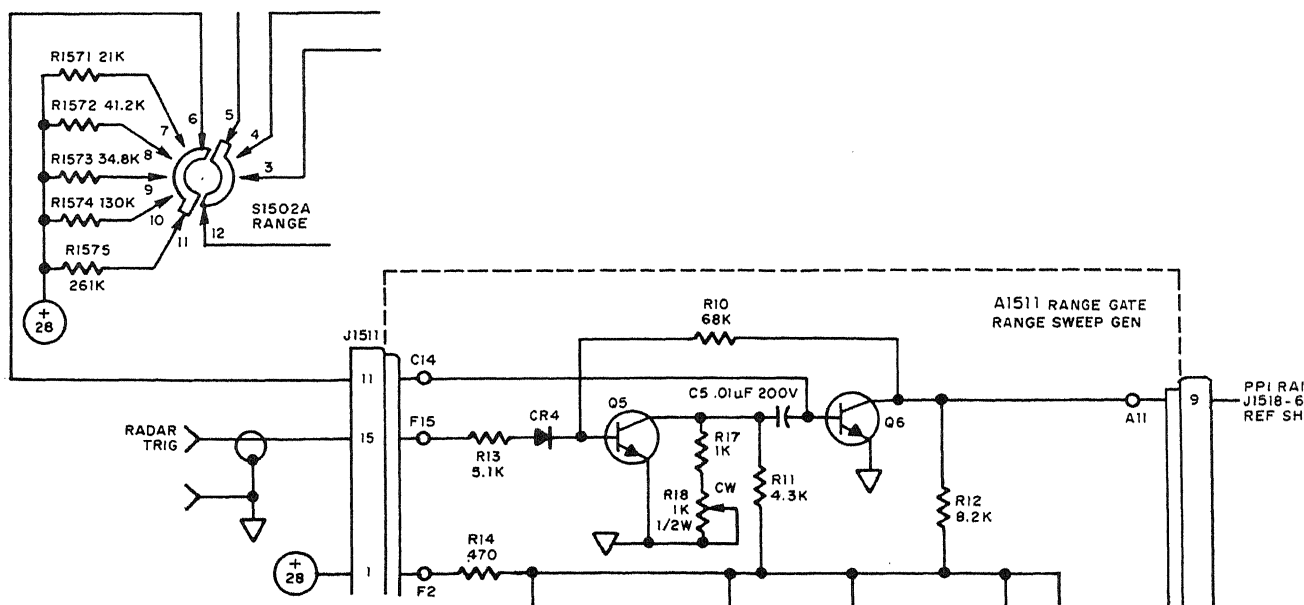


FIGURE 1

A. PPI range gate

- 1.
- 2.
- 3.
- 4.
- 5.

B. Pedestal amplifier, A1518 board, Q1

- 1.
- 2.

3.

C. Pedestal amplifier, A1518 board, Q7

1.

2.

3.

D. Sweep generator

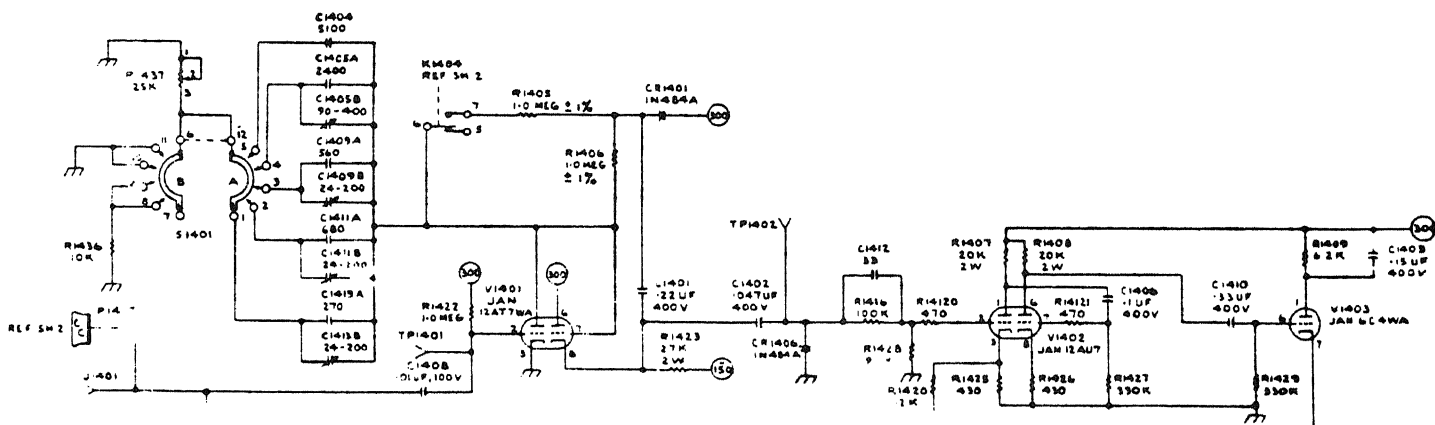


FIGURE 2

1.

2.

3.

4.

E. Deflection channels

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

11.

F. Bomb Director mode

1.

2.

3.

4.

G. Outputs

IV. Azimuth Marker Generator

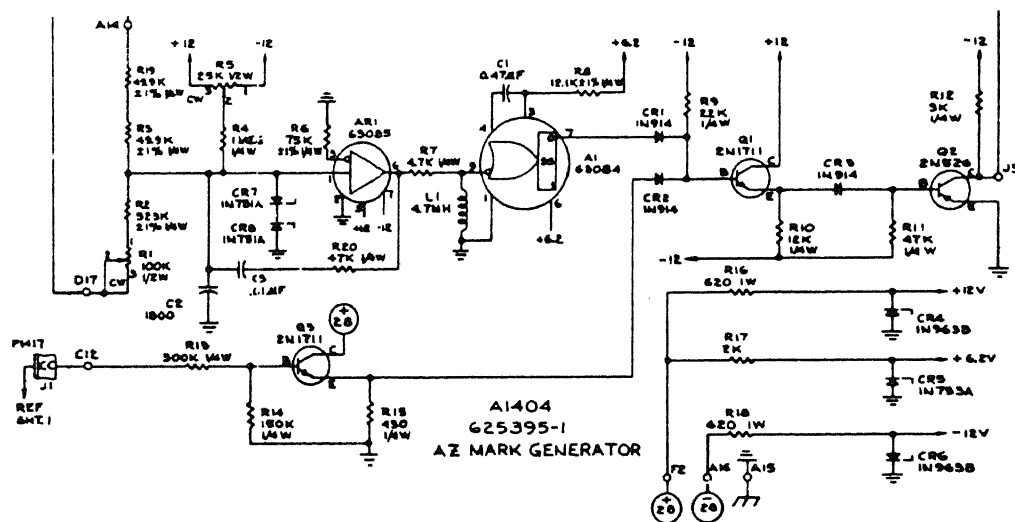


FIGURE 3

A.

B.

1.

2.

3.

4.

5.

V. Video Amplifiers - V1412 and V1413

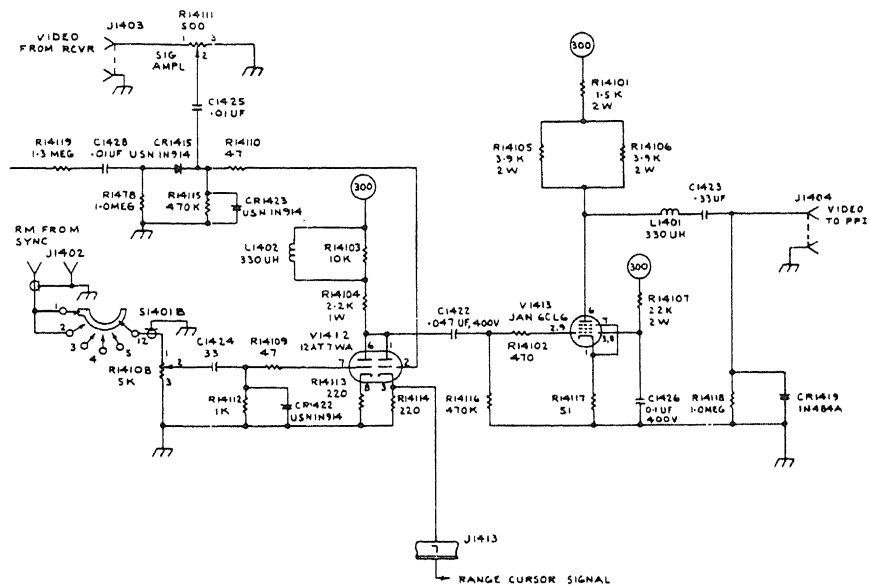


FIGURE 4

A.

- 1.
- 2.
- 3.
- 4.

B.

- 1.

2.

3.

4.

5.

6.

ASSIGNMENT SHEET 7.3.1A

B-GUN DISPLAY GENERATION AND SEQUENCE

INTRODUCTION

The purpose of this assignment sheet is to provide you with a review of the B-gun displays, circuit components, circuit operation, and the purposes of all circuit boards in the 1500 unit as they relate to the production of the B-gun displays. The completion of this assignment will enhance your knowledge about the operation of the B-gun circuitry. After completing this assignment sheet you will be better able to trace the signal flow, identify component functions and explain internal circuit operation.

LESSON TOPIC LEARNING OBJECTIVES

- 12.4.125 SELECT, from a given list of symbols, the ones displayed on the B-gun indicator in the Fire Control Automatic Search submode of operation.
- 12.4.126 SELECT, from the list of symbols, the ones displayed on the B-gun indicator in the Fire Control Automatic Track submode of operation.
- 12.4.127 SELECT, from a given list of deflection signals, the ones necessary to display the range trace.
- 12.4.128 SELECT, from a given list, the type of modulation used for target video.
- 12.4.129 SELECT, from a given list of deflection signals, the ones necessary to display the acquisition symbols.
- 12.4.130 SELECT, from a given list, the purpose, circuit characteristics, and circuit operation of the Range Sweep Generator (A1511).
- 12.4.131 SELECT, from a given list, the purpose, circuit characteristics, and circuit operation of the Peak Detector (A1513).
- 12.4.132 SELECT, from a given list, the purpose, circuit characteristics, and circuit operation of the 20 kHz Oscillator (A1515).
- 12.4.133 SELECT, from a given list, the purpose, circuit characteristics, and circuit operation of the 10 kHz Multivibrator (A1516).

- 12.4.134 SELECT, from a given list, the purpose, circuit characteristics, and circuit operation of the Acquisition Symbol Generator (A1514).
- 12.4.135 SELECT, from a given list, the purpose, circuit characteristics, and circuit operation of the Horizontal Switch (A1517).
- 12.4.136 SELECT, from a given list, the purpose, circuit characteristics, and circuit operation of the Pedestal Amplifier (A1518).
- 12.4.137 SELECT, from a given list, the purpose, circuit characteristics, and circuit operation of the B-gun Deflection Amplifier (A1519).

STUDY ASSIGNMENT

Answer the following questions utilizing Notetaking Sheet 7.3.1N.

1. What symbols are displayed by the B-gun in the Fire Control Automatic Search submode?
2. Target video is _____ modulated on the B-gun sweep.
3. What component controls the horizontal position of the acquisition symbol?
4. Why is the range notch developed around the target?
5. What is the purpose of modulating the horizontal deflection signal for the range trace with 60 Hertz?
6. What is the vertical deflection signal for the acquisition symbol?
7. Why is there no delay between the horizontal deflection signal for range trace and the horizontal signal for acquisition marks?

8. What is the purpose of the Peak Detector?
9. How many inputs to the 20 kHz oscillator (A1515)?
10. What is the output of J1516-pin 3?
11. What is the output of the Acquisition Symbol Generator (A1514) in the Fire Control Track submode?
12. The polarity of the d-c voltage at J1517-pin 7 indicates what?
13. What is the purpose of the B-gun Deflection Amplifier (A1519)?
14. What are the inputs to the Acquisition Symbol Generator?
15. What is the purpose of Q1502 and when will it conduct?
16. What circuit is formed by Q2 and Q3 in the A1511 board?
17. What determines the pulse duration of the sawtooth at J1511-pin 13?
18. What is the input at J1513-pin 5?
19. What components comprise the Colpitts oscillator in the A1515 board?

20. What components comprise the integrator that shapes the 20 kHz back-to-back sawtooth and where are they located?
21. Where does the nutation signal at J1510-pin 15 come from?
22. C1 and R1, A1514 board, comprise what type of circuit?
23. Q1 and Q2, A1514 board, comprise what type of circuit?
24. The circuit formed by Q1 and Q2 (A1514) is used for what purpose?
25. What is the purpose of the acquisition symbol gate?
26. When is the input from K1503 applied to J1514-pin 14 and what is its function?
27. Q3, A1517 board, is a _____ for paraphrase amplifier Q2 and Q4.
28. Why is the 20 kHz back-to-back sawtooth applied to the video amplifiers?

NOTETAKING SHEET 7.3.1N

B-GUN DISPLAY GENERATION AND SEQUENCE

REFERENCES

- Aviation Fire Control Technician 3 & 2, NAVEDTRA 10387-B, Chapter 12, pages 329-332.
- Maintenance Handbook for Basic Fire Control Radar Maintenance Training Sets, Devices 11D13 and 11D13A, NAVEDTRA P-2974-1, December 1968, Section 3, "Theory of Operation", pages 3-42 through 3-53.

NOTETAKING OUTLINE

I. B-Gun Displays

A.

1.

2.

3.

B.

1.

2.

3.

4.

II. Analysis of the B-gun Deflection Signals

A.

1.

2.

3.

4.

5.

6.

7.

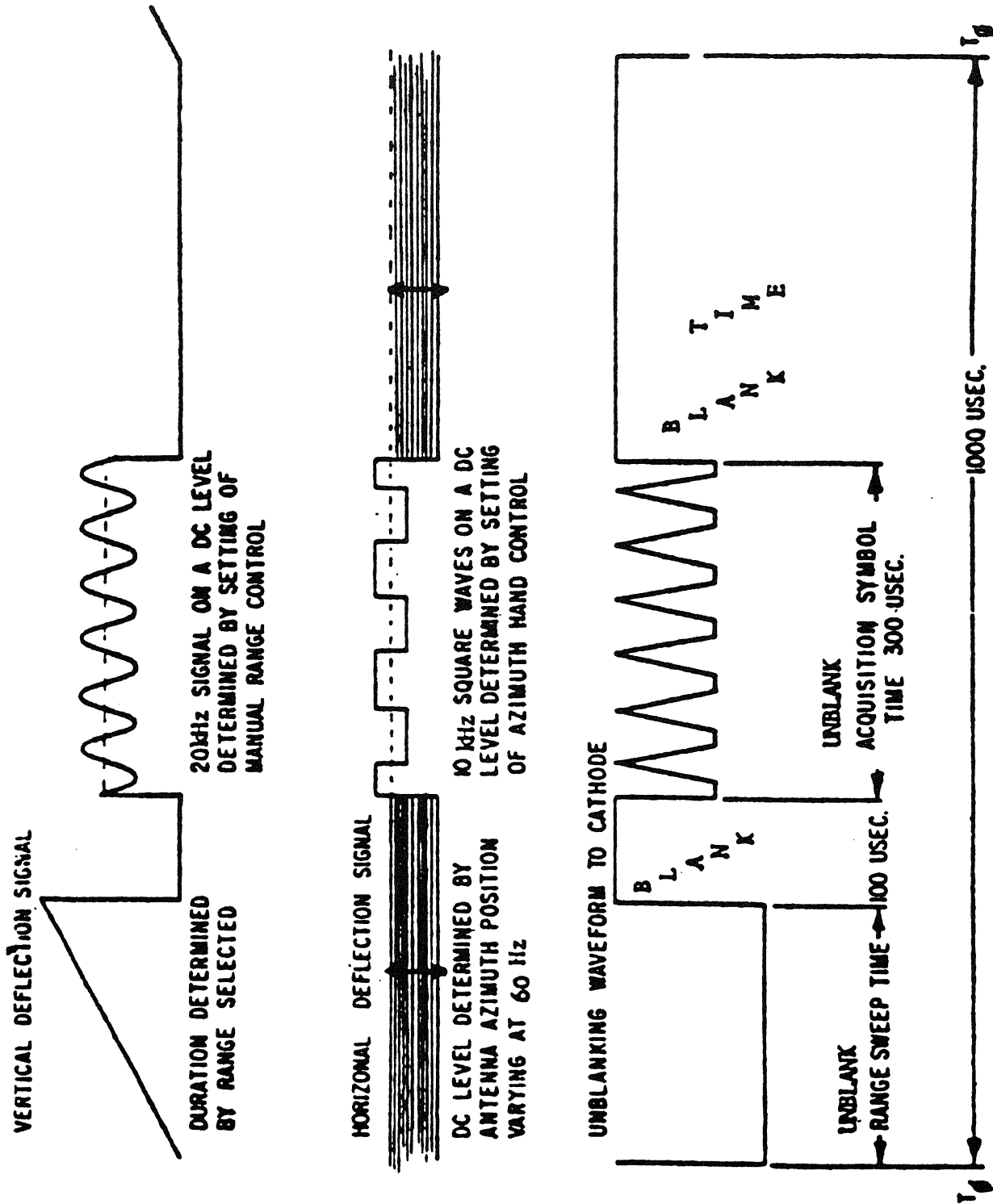
B.

1.

2.

3.

4.



FIRE CONTROL SEARCH SUBMODE OF OPERATION HORIZONTAL, VERTICAL AND UNBLANKING SIGNALS TO THE B-GUN

FIGURE 1

VERTICAL DEFLECTION SIGNAL

DURATION DETERMINED
BY RANGE SELECTED

HORIZONTAL DEFLECTION SIGNAL

RANGE STROBE DEFLECTION SIGNAL IN COINCIDENCE
IN TIME WITH ACQUIRED TARGET

DC LEVEL DETERMINED BY
ANTENNA AZIMUTH POSITION
VARYING AT 60 Hz

JIZZLE
VOLTAGE

UNBLANKING WAVEFORM TO CATHODE

UNBLANK
TIME

BLANK TIME

RANGE SWEEP TIME

1000 USEC.

FIRE CONTROL TRACK SUBMODE OF OPERATION HORIZONTAL, VERTICAL AND
UNBLANKING SIGNALS TO THE B-GUN

III. Block diagram analysis

NOTE: Have students refer to schematic booklet, page 20 or page 23 and take notes on the diagrams.

IV. Schematic diagram

NOTE: Refer to schematic booklet, page 25, and take notes on your schematic.

ASSIGNMENT SHEET 7.4.1A

A-GUN DISPLAY GENERATION AND SEQUENCE

INTRODUCTION

The purpose of this assignment sheet is to provide you with a review of the A-gun Display Generation and Sequence lesson. The completion of this assignment will enhance your comprehension of the material presented in the classroom on the A-gun circuitry. After completing this assignment you will be better able to trace signal flow, identify component functions, and explain the internal operation of the A-gun circuitry.

LESSON TOPIC LEARNING OBJECTIVES

- 12.4 ISOLATE an instructor-induced malfunction (under limited supervision) on an avionics RADAR training device to a weapons replaceable assembly, a shop replaceable assembly, a stage, and a component, and RECORD results on job sheets. Test equipment will be provided. Performance must be accomplished in accordance with the Maintenance Handbook for Basic Fire Control Radar Maintenance Training Sets, Devices 11D13 and 11D13A, Vol. I and II, NAVEDTRA P-2974-1. All safety precautions must be observed in accordance with OPNAVINST 5101.2 (series).
- 12.3.138 SELECT, from a given list, the symbols displayed by the A-gun in the Fire Control Automatic Search, Automatic Track, and the Breakaway "X" submodes of operation.
- 12.4.139 SELECT, from a given list, the purpose of the symbols displayed by the A-gun.
- 12.4.140 SELECT, from a given list, the sequencing of the A-gun display at distances greater and less than 3500 yards to the target.
- 12.4.141 SELECT, from a given list, the purpose, circuit characteristics, and circuit operation of the 500 Hz Reference Oscillator (A1501).
- 12.4.142 SELECT, from a given list, the purpose, circuit characteristics, and circuit operation of the Range Circle Generator (A1506).
- 12.4.143 SELECT, from a given list, the purpose, circuit characteristics, and circuit operation of the Breakaway Generator (A1505).

- 12.4.144 SELECT, from a given list, the purpose, circuit characteristics, and circuit operation of the Amplifier Gate Generator (A1503).
- 12.4.145 SELECT, from a given list, the purpose, circuit characteristics, and circuit operation of the Buffer Amplifier (A1510).
- 12.4.146 SELECT, from a given list, the purpose, circuit characteristics, and circuit operation of the Gate Multivibrator (A1502).
- 12.4.147 SELECT, from a given list, the purpose, circuit characteristics, and circuit operation of the Vertical Gate (A1507).
- 12.4.148 SELECT, from a given list, the purpose, circuit characteristics, and circuit operation of the Horizontal Gate (A1508).
- 12.4.149 SELECT, from a given list, the purpose, circuit characteristics, and circuit operation of the A-gun Driver (A1509).
- 12.4.150 SELECT, from a given list, the purpose, circuit characteristics, and circuit operation of the A-gun Deflection Amplifier (A1520).
- 12.4.151 SELECT, from a given list, the purpose, circuit characteristics, and circuit operation of the Blanking Generator (A1504).
- 12.4.152 SELECT, from a given list, the purpose, circuit characteristics, and circuit operation of the Pedestal Amplifier (A1518).
- 12.4.153 SELECT, from a given list, the A-gun time frames affected by K1503.
- 12.4.154 SELECT, from a given list, the purpose, circuit characteristics, and circuit operation of the breakaway relay, K1501.

STUDY ASSIGNMENT

Answer the following questions using Notetaking Sheet 7.4.1N, along with your block and schematic diagrams.

STUDY QUESTIONS

- 1. What symbols are displayed by the A-gun?
- 2. What is the purpose of the A-H line?
- 3. What does the steering dot represent?
- 4. How many time frames are there in one A-gun cycle?
- 5. How long is one complete cycle of the A-gun?
- 6. _____ is the key to whether the range circle or the breakaway "X" is displayed.
- 7. What type of oscillator is contained in A1501?
- 8. When is A1501 disabled and how is it disabled?
- 9. What is the reference frequency of the A-gun?
- 10. What is the purpose of the buffer amplifier (A1510)?

11. What would the roll input at J1522-pin 10 be if the aircraft were at a 20-degree roll?
12. What circuit board initiates the time sharing function?
13. The A1507 board (Vertical Gate) is composed of four identical _____ gates.
14. What is the purpose of the Blanking Generator (A1504)?
15. K1503 affects time _____ and time _____.
16. What is the purpose of the A-gun Deflection Amplifier?
17. Give a basic circuit description of the oscillator inhibit signal.
18. What is the function of raysistor K1504?
19. The balanced bridge in the A1506 board does what?
20. The size of the range circle depends on a/an _____ or a/an _____ target range.
21. R20, A1505 board does what?
22. R10 in the secondary of T1 (A1505 board) is used to control the _____ of the A1505 board's outputs.
23. What component determines whether the range circle or the breakaway "X" deflection signals are gated through?

24. R6 and C2 (A1503 board) comprise what type of circuit?
25. The output at J1503-pin 14 is:
26. What do the polarity and amplitude of the voltage at J1510-pin 6 represent?
27. There is no A-gun display. A possible cause is:
- a. Q1, A1503 board
 - b. Q8, A1511 board
 - c. Q4, A1504 board
 - d. Q3, A1507 board
28. There is no A-H line displayed. A possible cause is:
- a. Q2, A1518 board
 - b. Q1, A1507 board
 - c. Q1, A1503 board
 - d. Q2, A1508 board
29. There is no range circle displayed by the A-gun (all other symbols operate normally). List the possible faulty boards.
30. The A1502 board is composed of three _____.
31. Q3, A1520 is a _____ for Q1 and Q2.
32. How do Q1, Q2, and Q4 in the A1504 board get collector voltage?
33. The transistors in the A1507 board must have _____ on their bases in order to qualify the gate.
34. What is the purpose of the voltage at J1507-pin 3?
35. The output of the A1520 board is connected where?

NOTETAKING SHEET 7.4.1N

A-GUN DISPLAY GENERATION AND SEQUENCE

REFERENCES

1. Aviation Fire Control Technician 3 & 2, NAVEDTRA 10387-B, Chapter 12, pages 325-329.
2. Maintenance Handbook for Basic Fire Control Radar Maintenance Training Sets, Devices 11D13 and 11D13A, Vol. 1 of 2, NAVEDTRA P-2974-1, December 1968, Section 3, "Theory of Operation", pages 3-26 through 3-42.

NOTETAKING OUTLINE

I. A-gun Displays

A.

1.

2.

3.

4.

B.

1.

2.

3.

4.

C.

1.

2.

3.

4.

D.

1.

2.

3.

4.

II. A-gun Sequencing

A.

B.

C.

1.

2.

3.

D.

1.

2.

E.

1.

2.

3.

1.

2.

3.

G.

1.

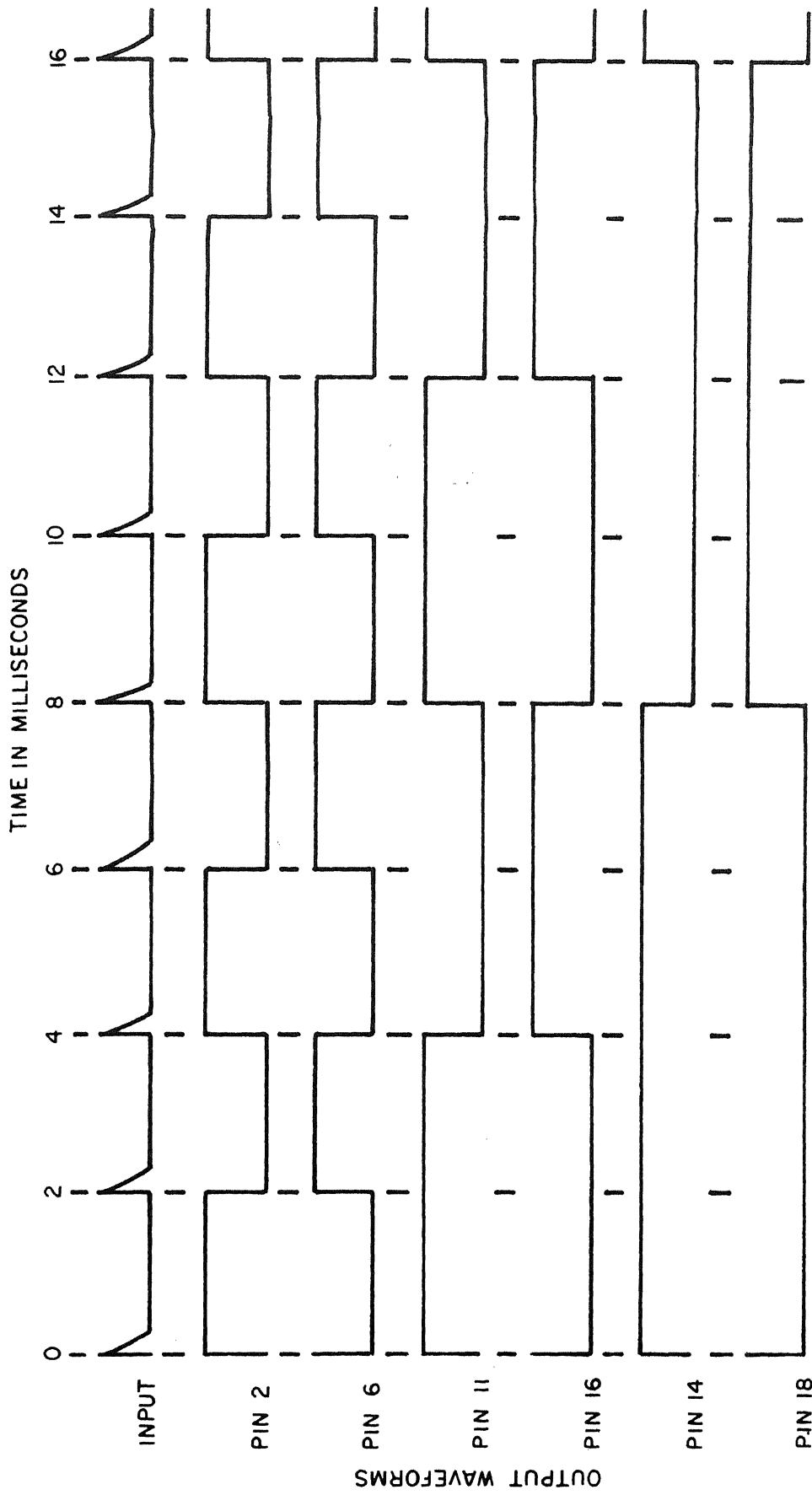
2.

H. Block Diagram Analysis

NOTE: Refer to page 17 in your schematic booklet and take your notes on the block diagram of the A-gun.

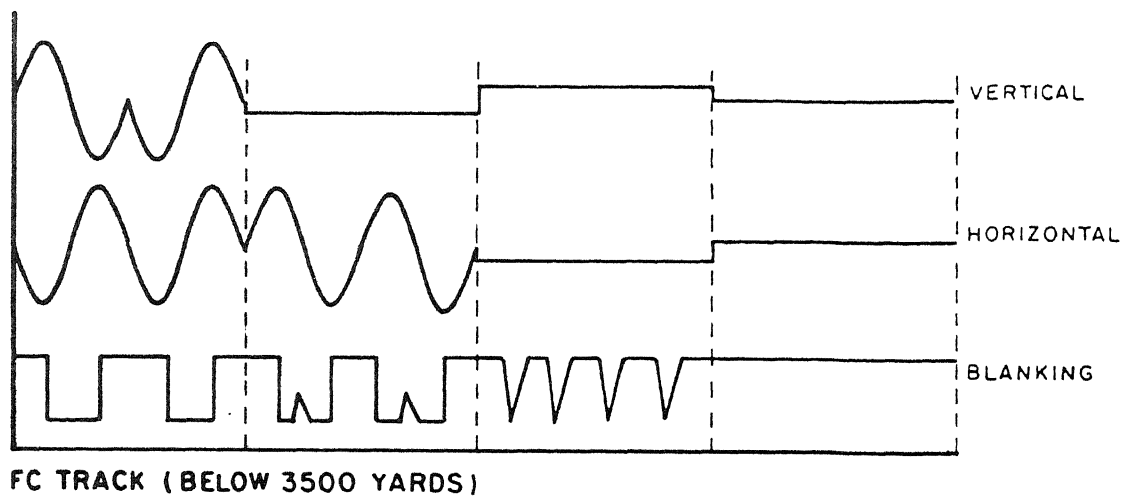
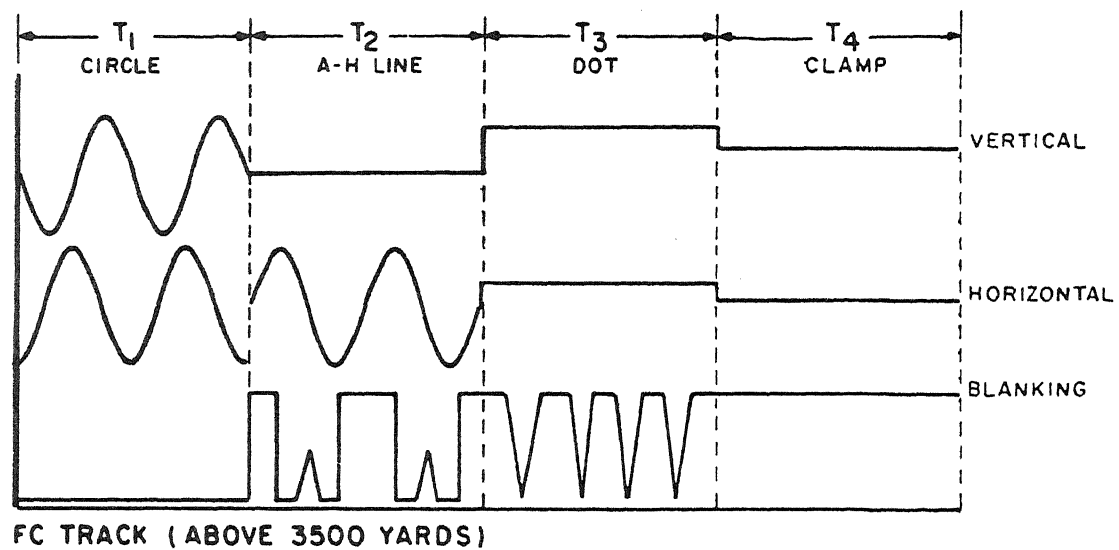
I. Schematic Analysis

NOTE: Refer to your schematic booklet, page 24 and take your notes on the A-gun schematic diagram.



GATE MULTIVIBRATOR AI502

FIGURE 1



A-GUN DEFLECTION AND BLANKING WAVEFORMS

FIGURE 2

AV - 56 - 84

DISPLAY ANALYSIS CHECKS

INTRODUCTION

To be an effective technician, you must have an understanding of how your equipment operates. The purpose of this lab assignment is to enhance your knowledge of basic RADAR displays and how the units within the RADAR work together to produce the displays on the scopes. You will observe key test points, analyze what you see and answer questions related to these waveforms.

ENABLING OBJECTIVES:

- 12.2.1 PERFORM a visual inspection of an avionics radar training device for physical defects, security, integrity, and proper installation, and RECORD results in accordance with standards outlined on the job sheets.
- 12.2.2 OBSERVE and ANALYZE waveforms, and ANSWER conclusions related to these waveforms taken in the Indicator Video Unit (1400 unit), Indicator Display Unit (1500 unit), and the Range Tracking Unit (1900 unit) utilizing Job Sheet 7.5.1J "Display Analysis Checks".

REFERENCES:

- A. Maintenance Handbook for Basic Fire Control Radar Training Sets 11D13 and 11D13A, Vol. I and 2, NAVEDTRA P-2974-1.
- B. Aviation Fire Control Technician 3 & 2, NAVPERS 10387-B

EQUIPMENT AND MATERIALS:

- A. Job Sheet 7.5.1J
- B. 11D13A Radar Trainer
- C. Oscilloscope, Techtronix 2336YA
- D. Schematics 11D13A
- E. Oscilloscope clip-on probe tips (2)
- F. Oscilloscope straight probe tips (2)

PRECAUTIONS TO BE OBSERVED:

- A. +4000 Vd-c aquadag voltage on the CRT's (1500 unit).
- B. High voltages used as B+ in the 1400 and 1500 units.
- C. Personnel safety:
 - 1. No jewelry.
 - 2. No liquids at the trainer.
 - 3. Do NOT pull the 1500 unit completely out of its retaining rails.
 - 4. Ensure that all boards are properly secured before pushing the 1500 unit back in.
 - 5. Ensure that when boards are down (1500 unit), that they do NOT touch any metal parts of the trainer.

PROCEDURE:

- A. Pull out the 1500 unit and lower the A1511 board.
- B. Using the procedures outlined in earlier labs, place the trainer in the Fire Control Automatic Search submode.
 - 1. Draw and label all elements seen on the Fire Control scope.
 - 2. Ensure that the "O" scope probes have the clip-on tips installed.
 - 3. Secure power, and connect the channel "A" probe to A1511-A19. Apply power and place the trainer in Fire Control Automatic Search.
 - a. What is the name of this pulse?

- b. What is its PRT?
- c. What unit generates this signal?
- 4. Secure power and connect the channel "B" probe to A1511-A8. Apply power and place the trainer in Fire Control Automatic Search.
 - a. What is this waveform used for?
 - b. Describe all the circuit action in the A1511 board that stops the charging of C1513.
 - c. What is the charge time (or range sweep time) of C1513 in PPI? Why?
- 5. Secure trainer power, disconnect probes, raise the A1511 board, lower the A1514 board, and connect the channel "A" probe to A1514-A1.
- 6. Apply power to the trainer and acquire the Fire Control Automatic Search submode.
 - a. What is the name of this waveform?
 - b. What component is the primary control for the pulse width of this waveform?
 - c. What is the trailing edge of this waveform used for in the A1514 board?

7. Secure power, connect the channel "B" probe to A1514-C7, apply power, and place the trainer in Fire Control Automatic Search.
 - a. How much delay is there between the trailing edge of the waveform on channel "A" and the leading edge of the waveform on channel "B"? (Theoretical)
 - b. In relation to T_0 , at what specific time does the leading edge of the waveform on channel "B" occur?
 - c. What deflection and/or unblanking signals will this waveform gate to the CRT and what symbol will be produced?
8. Secure power, connect the channel "A" probe to A1514-D17. Apply power and acquire Fire Control Automatic Search.
 - a. What is the name of this signal and its purpose?
 - b. What components are used as an integrator to develop the back-to-back sawtooth and where are they located?
 - c. What is the frequency of the back-to-back sawtooth waveform?
9. Secure power, connect the channel "A" probe to A1514-C15. Apply power and acquire Fire Control Automatic Search.
 - a. In relation to T_0 , at what time does the leading edge of the 20 kHz sine wave occur?
 - b. Varying R1461 does what to this waveform?

10. With the channel "B" probe, CAREFULLY touch the case of transistor Q6-A1514 (fifth transistor down from the top). The metal tip on the probe must be extended.
 - a. What is the frequency of this sine wave?
 - b. What type of oscillator is used to generate this sine wave and where is it located?
 - c. How many of the three outputs of this oscillator are used in developing the acquisition symbol?
11. Secure trainer power, disconnect probes, raise the A1514 board, lower the A1519 board, and connect the channel "A" probe to A1519-C5. Apply trainer power and acquire Fire Control Automatic Search.
 - a. What is the waveform on channel "A" used for?
 - b. Draw the portion of this waveform that is used to develop the acquisition symbol, and label the different parts of the waveform.
 - c. What is the PRT of the waveform on channel "A"?
12. Secure power and connect the channel "B" probe to A1519-C13. Apply power and acquire Fire Control Automatic Search.
 - a. What is this waveform used for?
 - b. What is the condition of diodes CR3 and CR4 during acquisition symbol time (A1517 board)?

- c. R1460 adjust what portion of this waveform?
-
- 13. Secure trainer power, disconnect probes, raise the A1519 board, lower the A1518 board, and connect the channel "A" probe to A1518-F20. Apply trainer power and acquire Fire Control Automatic Search.
 - a. When does the leading edge of this waveform occur?
 - b. Draw the waveform that would be seen at this test point in the Fire Control Automatic Track submode.
 - c. How does the relay action of K1503 cause this waveform to differ?
 - 14. Secure trainer power, connect the channel "A" probe to A1518-C7. Connect the "O" scope sync cable to the 1500 unit jack. Set the TIME/DIVISION control on the "O" scope to 2 msec per division. Lower the A1520 board and connect the channel "B" probe to A1520-C6. Apply power and acquire Fire Control Automatic Search.
 - a. What is the waveform on channel "A" used for?
 - b. What is the waveform on channel "B" used for?
 - c. How does the relay action of K1503 cause only the A-H line to be printed in Fire Control Automatic Search?

15. Secure trainer power, disconnect the probes, raise the A1518 board and the A1520 board, connect the "O" scope sync cable to J1603, push in the 1500 unit, secure "O" scope, and take a 15 minute break.

C. Turn on the "O" scope, pull out the 1500 unit, and lower the A1519 board. Turn on trainer power and acquire the Fire Control Automatic Track submode using a target greater than 3500 yards.

a. Draw and label all elements seen on the Fire Control indicator.

b. Secure trainer power, connect the channel "A" probe to A1519-C5, apply power, and acquire the Fire Control Automatic Track submode.

1. How does the relay action of K1503 cause only a sawtooth to be seen in the track submode?

2. What is the PRT of the waveform?

c. Set the TIME/DIVISION to .1 msec.

d. Secure trainer power, connect the channel "B" probe to A1519-C13, apply power, and acquire the Fire Control Automatic Track submode.

1. How does the relay action of K1503 cause the notch seen in the jizzle voltage?

2. In relation to T_0 , at what specific time does the notch occur?

3. Why does Q1502 only conduct in the Track submode?

e. Secure trainer power, disconnect the probes, raise the A1519 board and lower the A1520 board. Connect the "O" scope sync cable to the 1500 unit jack and set the TIME/DIVISION to the 2 msec position. Connect the channel "A" probe to A1520-C17 and the channel "B" probe to A1520-C6. Apply trainer power and acquire the Fire Control Automatic Track submode.

1. What is the phase relationship between the two waveforms occurring during Time 1?

2. What do the d-c levels during Time 3 indicate?

3. If the waveforms during Time 1 were decreasing in amplitude, what would be the relationship of the attack aircraft to the target in terms of range?
-
- f. Secure trainer power, raise the A1520 board, and lower the A1518 board. Connect the channel "A" probe to A1518-C7. Apply power and acquire the Fire Control Automatic Track submode.
 1. What portion of this waveform is used to unblank the indicator for the A-gun?
 2. What portion of this waveform is used to blank the A-gun?
 3. What A-gun time frames are affected by relay K1503?
-
- g. Secure power, raise the A1518 board, lower the A1505 board, and apply power. Using the procedures outlined in earlier labs, place the trainer in the Fire Control Breakaway X submode (The fast action switch must be held in to keep the trainer in the Breakaway X submode).
 1. Draw and label all elements seen on the Fire Control indicator.

2. Secure trainer power, connect the channel "A" probe to A1505-D20, connect the channel "B" probe to A1505-F12, and apply power. Acquire the Fire Control Breakaway X submode.

(a) What are these waveforms used for?

(b) What is the frequency of the waveform on channel "B"?

(c) What circuit characteristic in the A1507 board causes only 4 msec of the waveform on channel "A" to be displayed?

(d) What relay must be energized in order to pass the outputs of the A1505 board to the A1507 and A1508 boards?

(e) What component is used to set the range at which Breakaway "X" occurs?

3. Secure trainer power, disconnect probes, raise the A1505 board, connect the "O" scope sync cable to J1603, set the TIME/DIVISION to the .1 msec position, push in the 1500 unit, secure the "O" scope power, and take a 15 minute break.

- h. Turn on the "O" scope, pull out the 1500 unit, lower the A1511 and A1518 boards, connect the channel "A" probe to A1511-F15 and the channel "B" probe to A1518-C5. Apply power and place the trainer in the Bomb Director mode in accordance with procedures outlined in Job Sheet 6.2.1J.
 - 1. Draw and label all elements seen on the PPI indicator.
 - (a) When does the leading edge of the waveform on channel "A" occur?
 - (b) The waveform on channel "B" is used to trigger what circuits in the 1400 unit?
 - (c) What type of waveform will be developed by using this gate?
 - 2. Secure trainer power, disconnect the probes, raise the A1511 and A1518 boards, (Ensure that all 1500 unit boards are properly secured) and push in the 1500 unit.
 - 3. Change the "O" scope probe clip-on probe tips to straight tips. Apply power and place the trainer in the Bomb Director mode.

4. Connect channel "A" to TP1401.

(a) Range gate times (theoretical)

(1) 10,000 yards - _____ usec

(2) 40,000 yards - _____ usec

(3) 80,000 yards - _____ usec

5. Connect channel "B" to TP1934.

(a) What is the name of this pulse?

(b) What is this pulse used for in the Bomb Director mode?

(c) What component varies its position in relation to Time-Zero?

(d) What is this pulse used for in Fire Control Automatic Search?

(e) What is this pulse used for in Fire Control Automatic Track?

i. Using the procedures outlined in Job Sheet 6.2.1J, place the trainer in the PPI mode.

1. Draw and label all elements seen on the PPI indicator.

2. Connect the channel "A" probe to TP1401.
 - (a) Range gate times (theoretical)
 - (1) 6,000 yards - _____ usec
 - (2) 12,000 yards - _____ usec
 - (b) In what circuit board is the PPI range gate generated?
3. Connect the channel "A" probe to TP1403 and the channel "B" probe to TP1404.
 - (a) What is the phase relationship of these waveforms?
4. Connect the channel "B" probe to TP1405.
 - (a) What is the phase relationship between the waveforms of channels "A" and "B"?
 - (b) What component establishes this phase relationship?
5. Secure the trainer and the "O" scope, and answer the conclusions.

j. CONCLUSIONS

1. What controls the variable range mark on the PPI indicator in the SEARCH mode of operation?
2. What control is used to position the acquisition symbol horizontally on the indicator?

3. What control is used to position the acquisition symbol vertically on the indicator?
4. In the Fire Control Manual Search submode, what control determines the azimuth position of the antenna?
5. How many ranges are available in PPI?
6. What is the acquisition symbol used for?
7. Which gun in the Fire Control indicator displays the range trace?
8. Which gun in the Fire Control indicator displays the A-H line?
9. What is the purpose of the A-H line?
10. What is displayed by the B-gun in Fire Control Automatic Track?

11. What ranges are available in the SEARCH mode?

APPENDIX A

MALFUNCTION DESCRIPTION CODES ALPHABETICAL LIST

103	Attack Display Malfunction
963	Broken Filament/Cathode Terminal
080	Burned Out or Defective Light Bulb
029	Current Incorrect
242	Failed to Operate or Function - Specific Reason Unknown
748	Frequency Erratic or Incorrect
472	Fuse Blown or Defective Circuit Protector
816	Impedance Incorrect
958	Incorrect Display
169	Incorrect Voltage
374	Internal Failure
383	Lock on Malfunction
799	No Defect
957	No Display
255	No Output
450	Open
567	Resistance Incorrect
583	Scope Presentation Incorrect or Faulty
615	Shorted
649	Sweep Malfunction
695	Sync Absent or Incorrect
692	Video Faulty

NUMERICAL LIST

029	Current Incorrect
080	Burned Out or Defective Light Bulb
103	Attack Display Malfunction
169	Incorrect Voltage
242	Failed to Operate or Function - Specific Reason Unknown
255	No Output
374	Internal Failure
383	Lock on Malfunction
450	Open
472	Fuse Blown or Faulty Circuit Protector
567	Resistance Incorrect
583	Scope Presentation Incorrect or Faulty
615	Shorted
649	Sweep Malfunction
692	Video Faulty
695	Sync Absent or Incorrect
748	Frequency Erratic or Incorrect
799	No Defect
816	Impedance Incorrect
957	No Display
958	Incorrect Display
963	Broken Filament/Cathode Terminal

APPENDIX B

ACTION TAKEN CODES

- A. Item or Repairable Material or Weapons/Support System Discrepancy Checked-No Repair Required. This code is used for all discrepancies checked and found to require no maintenance actions. This code is used only if it is definitely determined that a reported deficiency does not exist or cannot be duplicated.
- C. Repair. This code is entered when a repairable item of material which is identified by a WUC is repaired. This includes cleaning disassembly, inspection, adjustment or reassembly, lubrication and/or replacement of integral parts. This code also applies to the correction of a discrepancy on a weapons/support system when appropriate.
- R. Remove and Replace. This code is entered when an item of material is removed and another like item is installed. (See also T and U.)
- T. Removed for Cannibalization. This code is used when an item of material is cannibalized.
- U. Replaced after Cannibalization. This code is entered when an item of material is replaced after cannibalization.

APPENDIX C

TRANSACTION CODES

Description-The transaction codes listed below are to be entered in block A32 of the VIDS/MAF. Transaction codes denote the type of data being reported.

11. (a) On-equipment work, not involving removal of defective or suspected defective components/items.

(b) On supporting engine documents, not having a removal of a defective or suspected defective component/item, when the engine is not specifically identified to a particular aircraft, e.g. JRPX.

(c) This code is also used at the organizational/intermediate level maintenance activities when closing out a maintenance action.
12. (a) On-equipment work (including engines), involving non-repairable components/items documented a failed parts.

(b) Engine identification documented in the FAILED/REQUIRED MATERIAL blocks (H-Z) and indexed (use TRcode 12).
23. Removal and replacement of a defective or suspected defective repairable component/item from an end item (excluding engine components/items). Additionally, this transaction code will be used for the removal and replacement of a complete engine assembly for a defect, suspected defect, or scheduled maintenance requirement. The removed component/item to be processed at an intermediate or depot level maintenance activity.
32. Work performed on a removed repairable component/item (including engines) with failed parts, awaiting parts, cannibalization actions, or engine identification documented in the FAILED/REQUIRED MATERIAL blocks. This action is normally performed at the intermediate level of maintenance.

APPENDIX D

WORK UNIT CODES FOR THE 11D13A

<u>Unit</u>	<u>Nomenclature</u>	<u>Subunit</u>	<u>Nomenclature</u>	<u>WUC</u>
11D13A	Fire Control Radar Maintenance Trainer			82000
700	Power Supply Indicator			82373
1400	Indicator Video			82732
1500	Indicator Display Module Boards			82760
		A1501	500 Hz Oscillator	82760-01
		A1502	Gate Multivibrator	82760-02
		A1503	Amp Gate Gen	82760-03
		A1504	Blank Gen	82760-04
		A1505	Breakaway Gen	82760-05
		A1506	Range Circle Gen	82760-06
		A1507	Vertical Gate	82760-07
		A1508	Horizontal Gate	82760-08
		A1509	A-gun Driver	82760-09
		A1510	Buffer Amp	82760-010
		A1511	Range Sweep Gen	82760-011
		A1513	Peak Detector	82760-013
		A1514	Acq Symbol Gen	82760-014
		A1515	20 kHz Osc	82760-015
		A1516	10 kHz Mult	82760-016
		A1517	Horiz Switch	82760-017
		A1518	Pedestal Amp	82760-018
		A1519	B-gun Def Amp	82760-019
		A1520	A-gun Def Amp	82760-020
1600	Synchronizer			82730
1900	Range Track			82759